DRAFT PAPER

ACNE DETECTION AND CLASSIFICATION USING DEEP LEARNING :A Review

Abstract:

Keywords:

Introduction:

Acne Vulgaris is a chronic inflammatory condition where it affects the sebaceous glands. The formation of Acne Vulgaris can be in the form of whiteheads, blackheads, small red tender bumps, pimples with pustules, nodules, and cystic lesions. The factors of acne can be many reasons, considering parameters such as hormonal changes, certain medications, diet, stress, hygiene, and family history. It impacts approximately 9.4% of the global population, with a particularly high prevalence among adolescents—up to 85% of this group experiences acne at some point. While often, it leads to mental illness such as lack of confidence and self-esteem.

Given the widespread incidence of acne and the psychological ramifications it entails, timely and accurate diagnosis is crucial. Traditional diagnostic methods, primarily reliant on visual assessment by dermatologists, are subject to inter-observer variability and can be time-consuming. As such, there is an urgent need for advancements in automated diagnostic tools. Recent developments in artificial intelligence (AI) and deep learning techniques offer promising alternatives to conventional methods.

Through there are various factors to prediction the acne which is impossible were we need to consider the various parameter,since traditional diagnostic methods where the primarily depends on the consultant the dermatologists which is time consuming process.To make this process easier using the Advancement of today's era of Artificial Intelligence an d Machine learning model using there advancement of the model where it can able to detect the type of the acne and severity level of it which is easier to analysis the treatment level for every acne type consuming the medicine is not only the solution to the problem following dietary sheet, maintain the mental health Understanding the root cause of it which is the best solution for the problem using the AI techniques understanding the severity level and taking medication

The evolution of the deep learning model for acne detection and classification.Considering,

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**INTRO PART (NEED TO CONFRIM FROM Ma’am)**

Acne is one of the most common dermatological conditions, affecting individuals of all ages, particularly adolescents and young adults. It is a chronic inflammatory skin disorder that arises due to the blockage of hair follicles by oil, dead skin cells, and bacteria. The primary types of acne include blackheads, whiteheads, papules, pustules, nodules, and cysts, each varying in severity and impact. The condition is influenced by several factors, including hormonal imbalances, genetic predisposition, diet, stress levels, and environmental factors. In addition to its physical manifestations, acne can have significant psychological consequences, leading to decreased self-esteem, anxiety, and even depression in severe cases. Given its widespread prevalence and impact, accurate detection and classification of acne are crucial for effective treatment and management.

Acne also has a significant influence on the beauty and skincare industry, driving the demand for dermatological treatments, cosmetics, and skincare products. The global market for acne treatment is continuously expanding, with consumers seeking over-the-counter solutions, prescription medications, and professional dermatological procedures. Skincare brands and cosmetic companies invest heavily in research and development to create innovative formulations that target acne prevention and treatment. Additionally, social media and influencer marketing play a critical role in shaping consumer perceptions of acne care, often promoting various skincare regimens and cosmetic solutions. The growing interest in AI-driven skincare analysis further highlights the intersection of deep learning and beauty technology, enabling personalized skincare recommendations based on acne severity and skin type.

Traditional acne diagnosis primarily relies on dermatological assessments, which can be subjective and prone to variability among different practitioners. The emergence of deep learning models in the field of medical imaging has provided promising solutions for automated acne detection and classification. Convolutional Neural Networks (CNNs) and other advanced deep learning architectures have demonstrated superior performance in analyzing dermatological images, reducing diagnostic subjectivity, and improving accuracy. Automated acne classification systems can help dermatologists and individuals in early detection, personalized treatment recommendations, and continuous monitoring of skin conditions.

Several research studies have explored deep learning techniques for acne detection and classification:

1. Discusses deep learning methodologies, datasets (CelebAMask-HQ, FFHQ), data augmentation techniques, and performance metrics (Dice Coefficient, F1 Score) for acne classification. [2] Proposes an acne detection method using GMM, including skin segmentation, acne candidate extraction (LoG-based), texture feature extraction (Gabor Filter, GLCM), and acne verification. Best results obtained using GLCM features in Cr-YCbCr channel. [3] Proposes a multi-scale dilated fully convolutional regressor with an attention mechanism for automated acne counting and severity grading. Uses UNet with dilated convolution filters and Faster R-CNN for bounding box-based attention. Dataset: ACNE04. [4] Develops an AI-based acne grading system using ResNet50 for lesion detection and severity assessment. Focuses on improving efficiency and reproducibility in clinical acne evaluation. [5] Uses object detection models (YOLOv5) trained on the ACNE04 dataset for acne classification. Achieves high accuracy for single-class and multi-class (severity grading) detection. Highlights strengths and weaknesses in lesion localization. [6] Implements pre-trained deep learning models (VGG16, ResNet50) with image preprocessing techniques to improve acne severity grading accuracy. [7] Introduces a lightweight CNN model optimized for mobile applications in acne detection, demonstrating comparable performance to state-of-the-art models. [8] Employs ensemble learning strategies by combining CNN models to enhance classification accuracy across multiple acne severity levels. [9] Integrates explainable AI techniques to improve model interpretability and decision-making in acne classification. [10] Evaluates various machine learning models, showcasing CNNs' superiority over traditional methods such as SVM and Random Forest. [11] Combines deep learning models with expert-driven rule-based systems to improve classification robustness. [12] Analyzes the impact of different image acquisition conditions on the performance of deep learning models for acne detection. [13] Explores the use of GANs to generate synthetic acne images for model training, improving classification performance. [14] Utilizes self-supervised learning methods to improve performance in scenarios with limited labeled training data. [15] Focuses on pixel-wise lesion segmentation using UNet and FCN architectures, enhancing detection and classification accuracy. [16] Develops AI-powered smartphone applications for real-time acne assessment and treatment recommendations. [17] Implements privacy-preserving federated learning techniques to train acne classification models across multiple institutions without data sharing. [18] Presents a validated AI algorithm (AIA) using the GEA scale, trained on 5972 images from diverse patients. Incorporates dermatologist-graded data, statistical validation, and clinical testing for robustness. [19] Reviews historical and modern acne grading scales, emphasizing their strengths and limitations. Discusses AI-based grading methods and future directions for improving assessment accuracy.[20] Investigates AI-based feature extraction techniques for dual modalities of Autism Spectrum Disorder neuroimages. Uses MRI techniques, functional connectivity analysis, and machine learning algorithms to improve ASD classification, achieving 88.67% accuracy. [21] Develops an automated segmentation and classification framework for histopathological nuclei images. Uses a hybrid methodology involving Canny edge detection, watershed transform, and machine learning classifiers to improve accuracy, achieving 85% ± 6% accuracy. [22] Proposes a machine learning-based skin cancer classification system using dermoscopy images. Employs image preprocessing, segmentation, feature extraction, and classification using SVM, KNN, and ensemble methods, achieving a maximum accuracy of 92%.